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TR-2093-ENV

PERFORMANCE EVALUATION OF A PILOT-SCALE PERMEABLE REACTIVE BARRIER AT FORMER NAVAL AIR STATION MOFFETT FIELD, MOUNTAIN VIEW, CALIFORNIA (APPENDICES - VOLUME II)

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13. ABSTRACT *(Maximum 200 words)*

A pilot scale permeable reactive barrier (PRB) or treatment wall demonstration project was initiated by the US Navy EFA West at the former Naval Air Station Moffett Field site in Mountain View, California about 3 years ago. Performance evaluations and cost-benefit analyses were performed by the US Naval Facilities Engineering Service Center (NFESC) and were sponsored by the Department of Defense (DoD) Environmental Security Technology Certification Program (ESTCP). The Moffett Field PRB uses a funnel-and-gate design, where the funnel is made of interlocking steel sheet piles and the gate consists of a reactive cell filled with zero-valent granular iron. Since its construction in April 1996, groundwater monitoring was conducted on a quarterly basis to demonstrate the effectiveness of the barrier technology in capturing and remediating groundwater that contained dissolved chlorinated hydrocarbon compounds. The primary contaminants of concern at Moffett Field in the vicinity of the PRB are trichloroethene (TCE), cis-1,2 dichloroethene (cDCE), and perchloroethene (PCE) at upgradient concentrations of about 2900 micrograms per liter (ug/L), 280 ug/L, and 26 ug/L, respectively. Quarterly monitoring events included water level measurements, field parameter testing, and groundwater sampling at about 75 monitoring points. Two tracer tests using bromide solutions and flow meter testing were also completed in April and August 1997 at the site. Iron cell coring samples were collected and analyzed in December 1997 for use as indicators of reactivity and longevity. Data from the quarterly monitoring, tracer testing, and iron cell coring have been used to determine the overall barrier performance. Since the first sampling event in June 1996, concentrations of all chlorinated compounds were either reduced to non-detect (ND) or to below the drinking water maximum contaminant levels (MCLs) within the first 2-3 feet of the permeable iron cell (gate).

The iron cell coring analyses and geochemical modeling from Moffett Field indicated that changes in the inorganic chemistry were caused by precipitation of calcite, carbonates, iron-sulfide, and hydroxide compounds. Chemical precipitates are a concern because of the potential loss of reactivity and permeability in the iron cell. In general, long-term performance and life expectancies at PRB sites are unknown. The DoD ESTCP, Environmental Protection Agency, and Department of Energy are sponsoring additional performance and longevity evaluations at multiple PRB sites across the country. This is being accomplished in partnership with the RTDF PRB Action Team in an effort to gain widespread regulatory acceptance and remedial project manager confidence in using the reactive barrier technology.

14. SUBJECT TERMS
Permeable reactive barrier; groundwater; remediation; zero-valent iron; treatment wall; chlorinated hydrocarbons; CVOC; TCE; PCE; DCE; VC; pump-and-treat alternative

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Appendix F
Quality Assurance

This section contains quality assurance data used to assess the validity of the groundwater sampling analyses. Results are presented for trip blanks, equipment rinsate blanks, field duplicate measurements (sampling precision), laboratory spike recoveries, and method blanks.

Table F-1a. Results of June 1996 Sampling at Moffett Field: Trip Blanks (μg/L)

Compound	Sample ID									
	TB-101	Detection Limit	TB-102	Detection Limit	TB-104	Detection Limit	TB-105	Detection Limit	Trip Blank	Detection Limit
1,1-DCA	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
1,2-DCA	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
1,1-DCE	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
cis-1,2-DCE	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
trans-1,2-DCE	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
PCE	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
TCE	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
Methylene Chloride	U	0.5	U	0.5	U	0.5	0.7	0.5	U	0.5
Vinyl Chloride	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
Carbon Tetrachloride	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
Chloroform	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
CFC-113	U	2	U	2	U	2	U	2	U	2

U: The compound was analyzed but not detected at or above the specified reporting limit.

Table F-1b. Results of June 1996 Sampling at Moffett Field: Equipment Rinsate Blanks (μg/L)

Compound	Sample ID			
	WW-101[(a)]	Detection Limit	WW-102 [(b)]	Detection Limit
1,1-DCE	U	2	6.8	2
cis-1,2-DCE	U	2	19	2
PCE	U	2	5.6	2
TCE	U	2	240	2
Chloroform	61	2	U	2

U: The compound was analyzed but not detected at or above the specified reporting limit.

(a) Equipment Rinsate after WW-3.

(b) Equipment Rinsate after WIC-1.

Table F-1c. Results of June 1996 Field Precision (μg/L)

Compound	WW-2				WW-11			
	WW-2[a]	WW-2-99[b]	Mean	RPD	WW-11[a]	WW-11-99[b]	Mean	RPD
1,1-DCA	29	18	23.5	47%	U	21	NA	NA
1,2-DCA	U	U	NA	NA	U	U	NA	NA
1,1-DCE	36	26	31	32%	U	27	NA	NA
cis-1,2-DCE	220	170	195	26%	8.2	100	54.1	170%
trans-1,2-DCE	U	U	NA	NA	U	U	NA	NA
PCE	12	13	12.5	8%	U	13	NA	NA
TCE	850	850	850	0%	35	330	182.5	162%
Methylene Chloride	U	U	NA	NA	U	U	NA	NA
Vinyl Chloride	U	U	NA	NA	U	U	NA	NA
Carbon Tetrachloride	U	U	NA	NA	U	U	NA	NA
Chloroform	U	U	NA	NA	U	U	NA	NA
1,1,1-TCA	5.9	3.9	4.9	41%	U	3	NA	NA
CFC-113[d]	1.4	3.9	2.65	94%	1.7	1.4	1.55	19%
HCFC-123[d]	1.4	3.9	2.65	94%	2.0	1.4	1.7	35%
Compound	**WW-12**				**W9-35**			
	WW-12[a]	WW-12-99[b]	Mean	RPD	W9-35-PER[a]	WW-99-5[c]	Mean	RPD
1,1-DCA	15	14	14.5	7%	27	31	29	14%
1,2-DCA	U	U	NA	NA	U	U	NA	NA
1,1-DCE	U	U	NA	NA	103	133	118	26%
cis-1,2-DCE	39	36	37.5	8%	380	280	330	30%
trans-1,2-DCE	U	U	NA	NA	U	U	NA	NA
PCE	U	U	NA	NA	180	250	215	33%
TCE	3.4	U	NA	NA	5,160	5,960	5,560	14%
Methylene Chloride	U	U	NA	NA	U	U	NA	NA
Vinyl Chloride	U	U	NA	NA	U	U	NA	NA
Carbon Tetrachloride	U	U	NA	NA	U	U	NA	NA
Chloroform	U	U	NA	NA	U	U	NA	NA
1,1,1-TCA	U	U	NA	NA	3.9	9.7	6.8	85%
CFC-113[d]	U	U	NA	NA	5.6	8.6	7.1	42%
HCFC-123[d]	1.51	1.51	1.51	0%	5.6 U	8.6	NA	NA

RPD is defined as [|primary–duplicate|/ ½(primary+duplicate)] x 100.
(a) Primary sample collected using a peristaltic pump.
(b) Duplicate sample collected in a bailer.
(c) Duplicate sample collected using a dedicated in-hole pump.
(d) Tentatively identified compound.
NA: Not available.
U: The compound was analyzed but not detected at or above the specified reporting limit.

Table F-1d. June 1996 Lab Recovery

Compound	WIC-1 MS (µg/L)	WIC-1 MSD (µg/L)	WIC-1 RPD	WW-4C MS (µg/L)	WW-4C MSD (µg/L)	WW-4C RPD
DBFM	113	103	9%	109	92	17%
1,2-DCA	98	95	3%	118	99	18%
Tol-d8	89	88	1%	93	94	1%
4-BFB	86	85	1%	98	95	3%

Compound	WW-7D MS (µg/L)	WW-7D MSD (µg/L)	WW-7D RPD	WW-8B MS (µg/L)	WW-8B MSD (µg/L)	WW-8B RPD
DBFM	97	91	6%	94	92	2%
1,2-DCA	87	75	15%	92	90	2%
Tol-d8	85	84	1%	104	105	1%
4-BFB	80	75	6%	94	91	3%

Compound	WW-12 MS (µg/L)	WW-12 MSD (µg/L)	WW-12 RPD	WW-13B MS (µg/L)	WW-13B MSD (µg/L)	WW-13B RPD
DBFM	96	99	3%	65	65	0%
1,2-DCA	86	84	2%	98	100	2%
Tol-d8	89	90	1%	98	99	1%
4-BFB	81	81	0%	92	96	4%

Compound	WW-16D MS (µg/L)	WW-16D MSD (µg/L)	WW-16D RPD
DBFM	96	91	5%
1,2-DCA	97	100	3%
Tol-d8	94	93	1%
4-BFB	95	89	7%

RPD is defined as [|MS-MSD|/ ½(MS+MSD)] x 100.
QC limits for RPD are ± 25% and recoveries are within limits.
DBFM: Dibromofluoromethane.
1,2-DCA: 1,2-DCA-d4.
Tol-d8: Toluene-d8.
4-BFB: 4-Bromofluorobenzene.

F-1e. June 1996 Method Blanks

Compound	Method Blanks	
	Result	Detection Limit (µg/L)
Benzene	U	2
Bromobenzene	U	2
Bromodichloromethane	U	2
Bromoform	U	2
Bromomethane	U	2
n-Butylbenzene	U	2
sec-Butylbenzene	U	2
tert-Butylbenzene	U	2
Carbon Tetrachloride	U	2
Chlorobenzene	U	2
Chloroethane	U	2
Chloroform	U	2
Chloromethane	U	2
2-Chlorotoluene	U	2
4-Chlorotoluene	U	2
Dibromochloromethane	U	2
1,2-Dibromo-3-chloropropane	U	2
1,2-Dibromoethane	U	2
Dibromomethane	U	2
1,2-Dichlorobenzene	U	2
1,3-Dichlorobenzene	U	2
1,4-Dichlorobenzene	U	2
Dichlorodifluoromethane	U	2
1,1-Dichloroethane	U	2
1,2-Dichloroethane	U	2
1,1-Dichloroethene	U	2
cis-1,2-Dichloroethene	U	2
trans-1,2-Dichloroethene	U	2
1,2-Dichloropropane	U	2
1,3-Dichloropropane	U	2
2,2-Dichloropropane	U	2
1,1-Dichloropropene	U	2
Ethylbenzene	U	2
Hexachlorobutadiene	U	2
Isopropylbenzene	U	2
p-Isopropylbenzene	U	2
Methylene Chloride	U	2
Naphthalene	U	2
n-Propylbenzene	U	2
Styrene	U	2
1,1,1,2-Tetrachloroethane	U	2
1,1,2,2-Tetrachloroethane	U	2
Tetrachloroethene	U	2
Toluene	U	2
1,2,3-Trichlorobenzene	U	2
1,2,4-Trichlorobenzene	U	2
1,1,1-Trichloroethane	U	2
1,1,2-Trichloroethane	U	2
Trichloroethene	U	2
Trichlorofluoromethane	U	2
1,2,3-Trichloropropane	U	2
1,2,4-Trimethylbenzene	U	2
1,3,5-Trimethylbenzene	U	2
Vinyl Chloride	U	2
Xylenes, Total	U	2

U: The compound was analyzed but not detected at or above the specified reporting limit.

Table F-2a. Results of September 1996 Sampling at Moffett Field: Trip Blanks (μg/L)

Compound	SAMPLE ID			
	TB-IC-1	TB-IC-2	TB-IC-3	TB-IC-4
1,1-DCA	U	U	U	U
1,2-DCA	U	U	U	U
1,1-DCE	U	U	U	U
cis-1,2-DCE	U	U	U	U
PCE	U	U	U	U
TCE	U	U	U	U
1,1,1-Trichloroethane	U	U	U	U
Methylene Chloride	U	U	U	U
Vinyl Chloride	U	U	U	U
Carbon Tetrachloride	U	U	U	U
Chloroform	U	U	U	U
HCFC-123	U	U	U	U
CFC-113	U	U	U	U
Benzene	U	U	U	U
Toluene	U	U	U	U
Ethylbenzene	U	U	U	U
Xylene (Total)	U	U	U	U

U: The compound was analyzed but not detected at or above the reporting limit.

Table F-2b. Results of September 1996 Sampling at Moffett Field: Equipment Rinsate Blanks (µg/L)

COMPOUND	SAMPLE ID											
	WW-101[a]	Detection Limit	WW-102[b]	Detection Limit	WW-103[c]	Detection Limit	WW-104[d]	Detection Limit	WW-105[e]	Detection Limit	WW-106[f]	Detection Limit
1,1-DCA	U	2	U	2	U	2	U	2	U	2	U	2
1,2-DCA	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
1,1-DCE	U	2	U	2	U	2	U	2	U	2	U	2
cis-1,2-DCE	U	2	2	2	U	2	U	2	U	2	U	2
PCE	U	2	2	2	U	2	U	2	U	2	U	2
TCE	1 J	2	74 E	2	U	2	U	2	U	2	U	2
1,1,1-Trichloroethane	U	2	U	2	U	2	U	2	U	2	U	2
Methylene Chloride	U	2	U	2	U	2	U	2	U	2	U	2
Vinyl Chloride	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
Carbon Tetrachloride	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
Chloroform	1 J	2	U	2	U	2	U	2	U	2	U	2
CFC-113	U	2	U	2	U	2	U	2	U	2	U	2
Benzene	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
Toluene	U	2	U	2	U	2	U	2	U	2	U	2
Ethylbenzene	U	2	U	2	U	2	U	2	U	2	U	2
Xylene (Total)	U	2	U	2	U	2	U	2	U	2	U	2

(a) Equipment Blank after WW-18C.
(b) Equipment Blank after WW-7D.
(c) Equipment Blank after WW-5.
(d) Equipment Blank after WW-3.
(e) Equipment Blank after WW-8D.
(f) Equipment Blank after WW-17D.
U: The compound was analyzed but not detected at or above the specified reporting limit.

Table F-2c. Results of September 1996 Field Precision (mg/L)

Compound	WIC-1				WW-7D			
	Primary	Duplicate	Mean	RPD	Primary	Duplicate	Mean	RPD
1,1-DCA	26	26	26	0%	25	26	25.5	4%
1,2-DCA	U	U	NA	NA	U	U	NA	NA
1,1-DCE	45	41	43	9%	31	35	33	12%
cis-1,2-DCE	260	240	250	8%	220 E	220 E	220	0%
PCE	15 J	17	16	13%	14	15	14.5	0%
TCE	1,400 E	1,100 E	1,250	24%	1,100 E	860 E	1,250	24%
1,1,1-Trichloroethane	U	U	NA	NA	8 J	8 J	8	0%
Methylene Chloride	U	7 J	NA	NA	U	8 J	NA	NA
Vinyl Chloride	U	U	NA	NA	U	U	NA	NA
Carbon Tetrachloride	U	U	NA	NA	U	U	NA	NA
Chloroform	U	U	NA	NA	U	U	NA	NA
HCFC-123	26 N, J	NA	NA	NA	NA	NA	NA	NA
CFC-113	40	39	39.5	3%	30	29	29.5	3%
Benzene	U	3	NA	NA	U	2 J	NA	NA
Toluene	U	U	NA	NA	U	U	NA	NA
Ethylbenzene	U	U	NA	NA	U	U	NA	NA
Xylene (Total)	U	7 J	NA	NA	U	U	NA	NA

Compound	WW-9C				WW-8C			
	Primary	Duplicate	Mean	RPD	Primary	Duplicate	Mean	RPD
1,1-DCA	8	7	7.5	13%	27	23	25	16%
1,2-DCA	U	U	NA	NA	U	U	NA	NA
1,1-DCE	U	U	NA	NA	U	U	NA	NA
cis-1,2-DCE	U	U	NA	NA	80 E	63 E	71.5	24%
PCE	U	U	NA	NA	U	U	NA	NA
TCE	1 J	U	NA	NA	U	U	NA	NA
1,1,1-Trichloroethane	U	U	NA	NA	U	U	NA	NA
Methylene Chloride	U	U	NA	NA	U	U	NA	NA
Vinyl Chloride	0.4 J	U	NA	NA	U	2	NA	NA
Carbon Tetrachloride	U	U	NA	NA	U	U	NA	NA
Chloroform	U	U	NA	NA	U	U	NA	NA
HCFC-123	24 N, J	NA	NA	NA	2 N, J	NA	NA	NA
CFC-113	U	U	NA	NA	U	U	NA	NA
Benzene	U	U	NA	NA	U	U	NA	NA
Toluene	U	U	NA	NA	U	U	NA	NA
Ethylbenzene	U	U	NA	NA	U	U	NA	NA
Xylene (Total)	U	U	NA	NA	U	U	NA	NA

Compound	WW-12				WW-13D			
	Primary	Duplicate	Mean	RPD	Primary	Duplicate	Mean	RPD
1,1-DCA	24	22	23	9%	1 J	1 J	1	0%
1,2-DCA	U	U	NA	NA	U	U	NA	NA
1,1-DCE	2	2	2	0%	2	2	2	0%
cis-1,2-DCE	87 E	85 E	71.5	24%	10	9	9.5	11%
PCE	U	U	NA	NA	U	U	NA	NA
TCE	U	U	NA	NA	6	6	6	0%
1,1,1-Trichloroethane	U	U	NA	NA	U	U	NA	NA
Methylene Chloride	U	U	NA	NA	U	U	NA	NA
Vinyl Chloride	2	2	2	0%	0.4 J	0.4 J	0.4	0%
Carbon Tetrachloride	U	U	NA	NA	U	U	NA	NA
Chloroform	U	U	NA	NA	U	U	NA	NA
HCFC-123	54 N, J	NA	NA	NA	5 N, J	NA	NA	NA
CFC-113	U	U	NA	NA	U	U	NA	NA
Benzene	0.3 J	U	NA	NA	0.4 J	0.4 J	0.4	0%
Toluene	U	U	NA	NA	U	U	NA	NA
Ethylbenzene	U	U	NA	NA	U	U	NA	NA
Xylene (Total)	U	U	NA	NA	U	U	NA	NA

RPD is defined as [|primary–duplicate|/ ½(primary+duplicate)] x 100.

NA: Not available. Calculation could not be performed due to insufficient data.

E: The amount reported exceeded the linear range of instrument calibration.

J: The compound was detected at an amount below the specified reporting limit. Consequently, the amount should be considered an estimated value.

U: The compound was analyzed but not detected at or above the specified reporting limit.

Table F-3a. Results of January 1997 Sampling at Moffett Field: Trip Blanks (µg/L)

Compound	Sample ID											
	TB-101	Detection Limit	TB-102	Detection Limit	TB-103	Detection Limit	TB-104	Detection Limit	TB-105	Detection Limit	TB-106	Detection Limit
1,1-DCA	U	2	U	2	U	2	U	2	U	2	U	2
1,2-DCA	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
1,1-DCE	U	2	U	2	U	2	U	2	U	2	U	2
cis-1,2-DCE	U	2	U	2	U	2	U	2	U	2	U	2
trans-1,2-DCE	U	2	U	2	U	2	U	2	U	2	U	2
PCE	U	2	U	2	U	2	U	2	U	2	U	2
TCE	U	2	U	2	U	2	U	2	U	2	U	2
Methylene Chloride	U	2	U	2	U	2	U	2	U	2	U	2
Vinyl Chloride	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
Carbon Tetrachloride	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
Chloroform	U	2	U	2	U	2	U	2	U	2	U	2
CFC-113	U	2	U	2	U	2	U	2	U	2	U	2

U: The compound was analyzed but not detected at or above the specified reporting limit.

Table F-3b. Results of January 1997 Sampling at Moffett Field: Equipment Rinsate Blanks (µg/L)

Compound	Sample ID									
	WW-101[a]	Detection Limit	WW-102[b]	Detection Limit	WW-103[c]	Detection Limit	WW-104[d]	Detection Limit	WW-105[e]	Detection Limit
1,1-DCA	U	2	U	2	U	2	U	2	U	2
1,2-DCA	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
1,1-DCE	U	2	U	2	U	2	U	2	U	2
cis-1,2-DCE	3	2	U	2	U	2	U	2	U	2
trans-1,2-DCE	U	2	U	2	U	2	U	2	U	2
PCE	U	2	U	2	U	2	U	2	U	2
TCE	9	2	U	2	U	2	U	2	U	2
Methylene Chloride	U	2	U	2	U	2	U	2	U	2
Vinyl Chloride	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
Carbon Tetrachloride	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
Chloroform	5	2	3	2	U	2	24	2	U	2
CFC-113	U	2	U	2	U	2	U	2	U	2

(a) Equipment Blank after WW-18C.
(b) Equipment Blank after WW-7D.
(c) Equipment Blank after WW-5.
(d) Equipment Blank after WW-3.
(e) Equipment Blank after WW-8D.
U: The compound was analyzed but not detected at or above the specified reporting limit.

Table F-3c. Results of January 1997 Field Precision (µg/L)

Compound	WIC-3				WW-15			
	WIC-3	WW-99-1	Mean	RPD	WW-15	WW-99-2	Mean	RPD
1,1-DCA	U	U	NA	NA	2	2	2	0%
1,2-DCA	U	U	NA	NA	U	U	NA	NA
1,1-DCE	U	U	NA	NA	U	U	NA	NA
cis-1,2-DCE	220	240	230	9%	1 J	1 J	1	0%
trans-1,2-DCE	U	U	NA	NA	U	U	NA	NA
PCE	U	U	NA	NA	U	U	NA	NA
TCE	1900	2200	2050	15%	3	3	3	0%
Methylene Chloride	U	U	NA	NA	U	U	NA	NA
Vinyl Chloride	U	U	NA	NA	U	U	NA	NA
Carbon Tetrachloride	U	U	NA	NA	U	U	NA	NA
Chloroform	U	U	NA	NA	U	U	NA	NA
CFC-113	U	U	NA	NA	U	U	NA	NA
Compound	**WIC-8**				**WW-10D**			
	WIC-8	WW-99-3	Mean	RPD	WW-10D	WW-99-4	Mean	RPD
1,1-DCA	U	U	NA	NA	U	U	NA	NA
1,2-DCA	U	U	NA	NA	U	U	NA	NA
1,1-DCE	U	U	NA	NA	U	U	NA	NA
cis-1,2-DCE	220	220	220	0%	U	U	NA	NA
trans-1,2-DCE	U	U	NA	NA	U	U	NA	NA
PCE	U	U	NA	NA	U	U	NA	NA
TCE	1200	1100	1150	9%	4	4	4	0%
Methylene Chloride	U	U	NA	NA	U	U	NA	NA
Vinyl Chloride	U	U	NA	NA	U	U	NA	NA
Carbon Tetrachloride	U	U	NA	NA	U	U	NA	NA
Chloroform	U	U	NA	NA	U	U	NA	NA
CFC-113	U	U	NA	NA	U	U	NA	NA
Compound	**WW-7B**				**WW-13D**			
	WW-7B	WW-99-5	Mean	RPD	WW-13D	WW-99-6	Mean	RPD
1,1-DCA	U	U	NA	NA	6	6	6	0%
1,2-DCA	U	U	NA	NA	U	U	NA	NA
1,1-DCE	U	U	NA	NA	U	U	NA	NA
cis-1,2-DCE	230	250	240	8%	2	2	2	0%
trans-1,2-DCE	U	U	NA	NA	U	U	NA	NA
PCE	U	U	NA	NA	U	U	NA	NA
TCE	1000	1100	1050	10%	U	U	NA	NA
Methylene Chloride	U	U	NA	NA	U	U	NA	NA
Vinyl Chloride	U	U	NA	NA	U	U	NA	NA
Carbon Tetrachloride	U	U	NA	NA	U	U	NA	NA
Chloroform	U	U	NA	NA	U	U	NA	NA
CFC-113	U	U	NA	NA	U	U	NA	NA

RPD is defined as [|primary–duplicate|/ ½(primary+duplicate)] x 100.

NA: Not available. Calculation could not be performed due to insufficient data.

J: The compound was detected at an amount below the specified reporting limit.

U: The compound was analyzed but not detected at or above the specified reporting limit.

Table F-4a. Results of April 1997 Sampling at Moffett Field: Trip Blanks (µg/L)

Compound	Sample ID													
	TB-101	Detection Limit	TB-102	Detection Limit	TB-103	Detection Limit	TB-104	Detection Limit	TB-105	Detection Limit	TB-106	Detection Limit	TB-107	Detection Limit
1,1-DCA	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
1,2-DCA	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
1,1-DCE	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
cis-1,2-DCE	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
trans-1,2-DCE	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
PCE	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
TCE	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
Methylene Chloride	U	4	U	4	4B	4	4B	4	U	4	U	4	U	4
Vinyl Chloride	U	1	U	1	U	1	U	1	U	1	U	1	U	1
Carbon Tetrachloride	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
Chloroform	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
CFC-113	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5

U: The compound was analyzed but not detected at or above the specified reporting limit.

B: The compound was detected in the associated method blank.

Table F-4b. Results of April 1997 Sampling at Moffett Field: Equipment Rinsate Blanks (µg/L)

Compound	Sample ID							
	WW-101[a]	Detection Limit	WW-102[b]	Detection Limit	WW-103[c]	Detection Limit	WW-104[d]	Detection Limit
1,1-DCA	U	0.5	U	2	U	1	U	0.5
1,2-DCA	U	0.5	U	2	U	1	U	0.5
1,1-DCE	U	0.5	U	2	U	1	U	0.5
cis-1,2-DCE	U	0.5	U	2	0.8J	1	4B	4
trans-1,2-DCE	U	0.5	U	2	U	1	0.3J	0.5
PCE	U	0.5	U	2	0.9J	1	U	0.5
TCE	U	0.5	U	2	41	1	U	0.5
Methylene Chloride	U	4	25B	20	U	8	U	0.5
Vinyl Chloride	U	1	U	0.8	U	0.32	NA	NA
Carbon Tetrachloride	U	0.5	U	2	U	1	2	0.5
Chloroform	2	0.5	2J	2	2	1	U	0.5
CFC-113	U	0.5	U	2	U	1	U	1
Compound	**WW-105[e]**	**Detection Limit**	**WW-106[f]**	**Detection Limit**	**WW-107[g]**	**Detection Limit**	**WW-108[h]**	**Detection Limit**
1,1-DCA	U	0.5	U	0.5	U	0.5	U	0.5
1,2-DCA	U	0.5	U	0.5	U	0.5	U	0.5
1,1-DCE	U	0.5	U	0.5	U	0.5	U	0.5
cis-1,2-DCE	U	0.5	U	0.5	U	0.5	U	0.5
trans-1,2-DCE	U	0.5	U	0.5	U	0.5	U	0.5
PCE	U	0.5	U	0.5	U	0.5	0.6	0.5
TCE	U	0.5	U	0.5	3	0.5	10	0.5
Methylene Chloride	U	4	U	4	U	4	U	4
Vinyl Chloride	U	1	U	1	U	1	U	1
Carbon Tetrachloride	U	0.5	U	0.5	U	0.5	U	0.5
Chloroform	1	0.5	2	0.5	0.8	0.5	2	0.5
CFC-113	U	0.5	U	0.5	U	0.5	0.6	0.5

(a) Equipment Blank after WW-5.
(b) Equipment Blank after WW-18C.
(c) Equipment Blank after WW-2.
(d) Equipment Blank after WW-17C.
(e) Equipment Blank after WW-1C.
(f) Equipment Blank after WW-8C.
(g) Equipment Blank after WW-13D.
(h) Equipment Blank after WIC-8.
NA: Not available.
B: The compound was detected in the associated method blank.
J: The compound was detected at an amount below the specified reporting limit.
U: The compound was analyzed but not detected at or above the specified reporting limit.

Table F-4c. Results of April 1997 Field Precision (µg/L)

Compound	WW-9C				WW-2			
	WW-9C	WW-99-1	Mean	RPD	WW-2	WW-99-2	Mean	RPD
1,1-DCA	8	8	8	0%	25	U	NA	NA
1,2-DCA	U	U	NA	NA	35	U	NA	NA
1,1-DCE	U	U	NA	NA	U	33 J	NA	NA
cis-1,2-DCE	U	0.6	NA	NA	U	270	NA	NA
trans-1,2-DCE	U	U	NA	NA	U	U	NA	NA
PCE	0.6	U	NA	NA	270	U	NA	NA
TCE	U	U	NA	NA	220 B	2,000	1,110	160%
Methylene Chloride	U	U	NA	NA	15 J	460 B	237.5	187%
Vinyl Chloride	U	U	NA	NA	U	U	NA	NA
Carbon Tetrachloride	U	U	NA	NA	1,900	U	NA	NA
Chloroform	U	U	NA	NA	24 J	U	NA	NA
CFC-113	U	U	NA	NA	U	U	NA	NA
Compound	WW-18D				WW-12			
	WW-18D	WW-99-3	Mean	RPD	WW-12	WW-99-4	Mean	RPD
1,1-DCA	1	8	4.5	156%	15	14	14.5	7%
1,2-DCA	U	U	NA	NA	2 J	U	NA	NA
1,1-DCE	U	U	NA	NA	U	U	NA	NA
cis-1,2-DCE	U	0.9	NA	NA	U	90	NA	NA
trans-1,2-DCE	U	U	NA	NA	U	U	NA	NA
PCE	4	U	NA	NA	97	U	NA	NA
TCE	U	U	NA	NA	U	6	NA	NA
Methylene Chloride	U	U	NA	NA	U	U	NA	NA
Vinyl Chloride	U	U	NA	NA	U	U	NA	NA
Carbon Tetrachloride	3	U	NA	NA	6	U	NA	NA
Chloroform	U	U	NA	NA	U	U	NA	NA
CFC-113	U	U	NA	NA	U	U	NA	NA
Compound	WW-1D				WW-13D			
	WW-1D	WW-99-5	Mean	RPD	WW-13D	WW-99-6	Mean	RPD
1,1-DCA	6	6	6	0%	6	7	6.5	15%
1,2-DCA	U	U	NA	NA	U	U	NA	NA
1,1-DCE	U	U	NA	NA	U	U	NA	NA
cis-1,2-DCE	U	3	NA	NA	U	1	NA	NA
trans-1,2-DCE	U	U	NA	NA	U	U	NA	NA
PCE	3	U	NA	NA	1	U	NA	NA
TCE	U	U	NA	NA	U	0.4 J	NA	NA
Methylene Chloride	U	U	NA	NA	U	U	NA	NA
Vinyl Chloride	U	U	NA	NA	U	U	NA	NA
Carbon Tetrachloride	U	U	NA	NA	0.4 J	U	NA	NA
Chloroform	U	U	NA	NA	U	U	NA	NA
CFC-113	U	U	NA	NA	U	U	NA	NA
Compound	WIC-8							
	WIC-8	WW-99-7	Mean	RPD				
1,1-DCA	19 J	23 J	21	19%				
1,2-DCA	21 J	U	NA	NA				
1,1-DCE	U	23 J	NA	NA				
cis-1,2-DCE	U	220	NA	NA				
trans-1,2-DCE	U	U	NA	NA				
PCE	200	13 J	106.5	176%				
TCE	U	1,300	NA	NA				
Methylene Chloride	12 J	U	NA	NA				
Vinyl Chloride	U	U	NA	NA				
Carbon Tetrachloride	1,200	U	NA	NA				
Chloroform	20 J	U	NA	NA				
CFC-113	U	22 J	NA	NA				

B: The compound was detected in the associated method blank.
J: The compound was detected at an amount below the specified reporting limit.
U: The compound was analyzed but not detected at or above the specified reporting limits.

RPD is defined as [|primary–duplicate|/ ½(primary+duplicate)] x 100.
NA: Not available. Calculation could not be performed due to insufficient data.

Table F-5a. Results of October 1997 Sampling at Moffett Field: Trip Blanks (µg/L)

Compound	Sample ID									
	TB-101	Detection Limit	TB-102	Detection Limit	TB-104	Detection Limit	TB-105	Detection Limit	Trip Blank	Detection Limit
1,1-DCA	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
1,2-DCA	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
1,1-DCE	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
cis-1,2-DCE	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
trans-1,2-DCE	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
PCE	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
TCE	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
Methylene Chloride	U	0.5	U	0.5	U	0.5	0.7	0.5	U	0.5
Vinyl Chloride	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
Carbon Tetrachloride	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
Chloroform	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
CFC-113	U	2	U	2	U	2	U	2	U	2

U: The compound was analyzed but not detected at or above the specified reporting limit.

Table F-5b. Results of October 1997 Sampling at Moffett Field: Equipment Rinsate Blanks (µg/L)

Compound	Sample ID									
	WW-101[a]	Detection Limit	WW-102[b]	Detection Limit	WW-103[c]	Detection Limit	WW-104[d]	Detection Limit	WW-105[e]	Detection Limit
1,1-DCA	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
1,2-DCA	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
1,1-DCE	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
cis-1,2-DCE	0.5	0.5	U	0.5	U	0.5	U	0.5	U	0.5
trans-1,2-DCE	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
PCE	U	0.5	0.9	0.5	U	0.5	U	0.5	U	0.5
TCE	11	0.5	16	0.5	U	0.5	U	0.5	U	0.5
Methylene Chloride	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
Vinyl Chloride	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
Carbon Tetrachloride	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
Chloroform	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5
CFC-113	U	2	U	2	U	2	U	2	U	2

(a) Equipment Rinsate after WW-16A.
(b) Equipment Rinsate after WIC-10.
(c) Equipment Rinsate after WW-18C.
(d) Equipment Rinsate after WW-13D.
(e) Equipment Rinsate after WW-8D.
U: The compound was analyzed but not detected at or above the specified reporting limit.

Table F-5c. Results of October 1997 Sampling Field Precision (µg/L)

Compound	WW-10C				WW-13C			
	WW-10C	WW-99-1	Mean	RPD	WW-13C	WW-99-2	Mean	RPD
1,1-DCA	0.7	0.8	0.75	13%	6	U	NA	NA
1,2-DCA	U	U	NA	NA	3	U	NA	NA
1,1-DCE	U	U	NA	NA	U	U	NA	NA
cis-1,2-DCE	1	2	1.5	67%	1	2	1.5	67%
trans-1,2-DCE	U	U	NA	NA	U	U	NA	NA
PCE	U	U	NA	NA	U	U	NA	NA
TCE	10	10	10	0%	U	U	NA	NA
Methylene Chloride	U	U	NA	NA	U	U	NA	NA
Vinyl Chloride	U	U	NA	NA	U	U	NA	NA
Carbon Tetrachloride	U	U	NA	NA	U	U	NA	NA
Chloroform	U	U	NA	NA	U	U	NA	NA
CFC-113	U	U	NA	NA	U	U	NA	NA
Compound	**WW-14**				**WW-5**			
	WW-14	WW-99-3	Mean	RPD	WW-5	WW-99-5	Mean	RPD
1,1-DCA	1	1	1	0%	2	2	2	0%
1,2-DCA	U	U	NA	NA	U	U	NA	NA
1,1-DCE	U	U	NA	NA	U	U	NA	NA
cis-1,2-DCE	0.6	0.8	0.7	29%	U	U	NA	NA
trans-1,2-DCE	U	U	NA	NA	U	U	NA	NA
PCE	U	U	NA	NA	U	U	NA	NA
TCE	U	U	NA	NA	U	U	NA	NA
Methylene Chloride	U	U	NA	NA	U	U	NA	NA
Vinyl Chloride	U	U	NA	NA	U	U	NA	NA
Carbon Tetrachloride	U	U	NA	NA	U	U	NA	NA
Chloroform	U	U	NA	NA	U	U	NA	NA
CFC-113	U	U	NA	NA	U	U	NA	NA
Compound	**WW-8D**				**WIC-8**			
	WW-8D	WW-99-6	Mean	RPD	WIC-8	WW-99-7	Mean	RPD
1,1-DCA	16	16	16	0%	23	19	21	19%
1,2-DCA	U	U	NA	NA	U	U	NA	NA
1,1-DCE	U	U	NA	NA	35	29	32	19%
cis-1,2-DCE	58	44	51	28%	170 D	290 D	230	52%
trans-1,2-DCE	U	U	NA	NA	3	1	2	100%
PCE	U	U	NA	NA	17	15	16	13%
TCE	0.8	0.7	0.75	13%	1,300 D	1,400 D	1,350	8%
Methylene Chloride	U	U	NA	NA	U	U	NA	NA
Vinyl Chloride	1	1	1	0%	U	U	NA	NA
Carbon Tetrachloride	U	U	NA	NA	U	U	NA	NA
Chloroform	U	U	NA	NA	U	U	NA	NA
CFC-113	U	U	NA	NA	14	U	NA	NA

RPD is defined as [|primary–duplicate|/ ½(primary+duplicate)] x 100.

NA: Not available. Calculation could not be performed due to insufficient data.

U: The compound was analyzed but not detected at or above the specified reporting limit.

D: The compound was detected in an analysis performed at a secondary dilution.

Table F-5d. October 1997 Lab Precision

Compound	WW-3 MS (µg/L)	WW-3 MSD (µg/L)	WW-3 % RPD	WW-1D MS (µg/L)	WW-1D MSD (µg/L)	WW-1D % RPD
Target Chlorinated Solvents						
PCE	9.350	8.303	12%	10.296	10.481	2%
TCE	10.932	12.062	10%	10.003	10.403	4%
cis-1,2-DCE	77.434	116.930	41%*	10.200	10.053	1%
Vinyl Chloride	8.509	9.478	11%	8.875	9.664	9%
Other Chlorinated Solvents						
1,1-DCA	20.712	31.901	43%*	12.916	12.781	1%
1,2-DCA	8.451	10.007	17%	8.776	8.926	2%
1,2-Dichlorobenzene	9.526	9.614	1%	9.604	9.656	1%
1,3-Dichlorobenzene	9.938	10.237	3%	10.512	10.428	1%
1,4-Dichlorobenzene	9.934	9.804	1%	9.968	10.164	2%
1,1-DCE	10.558	10.697	1%	10.161	10.380	2%
trans-1,2-DCE	8.845	11.378	25%	9.909	9.972	1%
1,2-Dichloropropane	9.139	10.003	9%	8.802	9.118	4%
cis-1,3-Dichloropropene	8.800	8.292	6%	8.833	8.905	1%
trans-1,3-Dichloropropene	8.618	8.226	5%	8.769	8.725	1%
1,1,2,2-Tetrachloroethane	8.983	9.430	5%	8.849	9.071	2%
1,1,1-Trichloroethane	9.142	12.017	27%*	11.094	11.193	1%
1,1,2-Trichloroethane	8.336	11.165	29%*	7.877	7.844	0%
Carbon Tetrachloride	9.100	8.993	1%	11.582	12.373	7%
Chlorobenzene	9.237	10.591	14%	10.783	10.692	1%
Chloromethane	7.719	9.783	24%	7.334	7.796	6%
Chloroethane	8.930	12.367	32%*	9.876	10.508	6%
Chloroform	9.092	13.392	38%*	10.355	9.916	4%
Methylene Chloride	8.916	12.330	32%*	9.211	9.066	2%
Bromodichloromethane	8.836	10.933	21%	9.616	9.914	3%
Dibromochloromethane	8.646	10.077	15%	9.872	9.774	1%
Trichlorofluoromethane	7.419	5.983	21%	8.828	9.957	12%
Other Organic Analytes						
Acetone	11.528	21.669	61%*	4.152	4.702	12%
Bromomethane	6.882	10.094	38%*	7.990	8.309	4%
Benzene	9.174	10.176	10%	9.572	9.768	2%
Bromoform	8.944	10.026	11%	9.617	9.408	2%
2-Butanone	9.196	7.255	24%	5.237	5.340	2%
Carbon Disulfide	9.841	7.548	26%*	9.916	9.725	2%
Ethylbenzene	9.400	10.213	8%	11.224	11.221	0%
2-Hexanone	11.924	7.771	42%*	6.311	6.599	4%
4-Methyl-2-pentanone	11.797	7.135	49%*	5.682	6.554	14%
Styrene	9.147	7.040	26%*	9.552	10.596	10%
Toluene	8.933	10.012	11%	9.350	9.602	3%
Vinyl Acetate	5.026	0.940	137%*	3.261	3.018	8%
m,p-Xylene	18.870	19.268	2%	22.517	22.171	2%
o-Xylene	9.233	10.453	12%	11.204	11.072	1%
Xylenes	28.390	30.764	8%	34.940	34.444	1%

RPD is defined as [|MS–MSD|/ ½(MS+MSD)] x 100.

* Values outside of QC limits (± 25%).

Table F-5e. October 1997 MS and MSD Recovery Rate (%)

Compound	WW-3						WW-1D					
	Unspiked (µg/L)	Spike Level (µg/L)	MS (µg/L)	MSD (µg/L)	MS Recovery (%)	MSD Recovery (%)	Unspiked (µg/L)	Spike Level (µg/L)	MS (µg/L)	MSD (µg/L)	MS Recovery (%)	MSD Recovery (%)
Target Chlorinated Solvents												
PCE	0.00	10.00	9.35	8.30	94%	83%	0.00	10.00	10.30	10.48	103%	105%
TCE	1.60	10.00	10.93	12.06	93%	105%	0.00	10.00	10.00	10.40	100%	104%
cis-1,2-DCE	62.52	10.00	77.43	116.93	149%*	544%*	0.00	10.00	10.20	10.05	102%	101%
Vinyl Chloride	0.00	10.00	8.51	9.48	85%	95%	0.00	10.00	8.88	9.66	89%	97%
Other Chlorinated Solvents												
1,1-DCA	11.93	10.00	20.71	31.90	88%	200%*	3.17	10.00	12.92	12.78	97%	96%
1,2-DCA	0.00	10.00	8.45	10.01	85%	100%	0.00	10.00	8.78	8.93	88%	89%
1,2-Dichlorobenzene	0.00	10.00	9.53	9.61	95%	96%	0.00	10.00	9.60	9.66	96%	97%
1,3-Dichlorobenzene	0.00	10.00	9.94	10.24	99%	102%	0.00	10.00	10.51	10.43	105%	104%
1,4-Dichlorobenzene	0.00	10.00	9.93	9.80	99%	98%	0.00	10.00	9.97	10.16	100%	102%
1,1-DCE	2.22	10.00	10.56	10.70	83%	85%	0.00	10.00	10.16	10.38	102%	104%
trans-1,2-DCE	0.00	10.00	8.85	11.38	88%	114%	0.00	10.00	9.91	9.97	99%	100%
1,2-Dichloropropane	0.00	10.00	9.14	10.00	91%	100%	0.00	10.00	8.80	9.12	88%	91%
cis-1,3-Dichloropropene	0.00	10.60	8.80	8.29	83%	78%	0.00	10.60	8.83	8.91	83%	84%
trans-1,3-Dichloropropene	0.00	9.40	8.62	8.23	92%	88%	0.00	9.40	8.77	8.73	93%	93%
1,1,2,2-Tetrachloroethane	0.00	10.00	8.98	9.43	90%	94%	0.00	10.00	8.85	9.07	88%	91%
1,1,1-Trichloroethane	0.00	10.00	9.14	12.02	91%	120%	0.00	10.00	11.09	11.19	111%	112%
1,1,2-Trichloroethane	0.00	10.00	8.34	11.17	83%	112%	0.00	10.00	7.88	7.84	79%	78%
Carbon Tetrachloride	0.00	10.00	9.10	8.99	91%	90%	0.00	10.00	11.58	12.37	116%	124%
Chlorobenzene	0.00	10.00	9.24	10.59	92%	106%	0.00	10.00	10.78	10.69	108%	107%
Chloromethane	0.00	10.00	7.72	9.78	77%	98%	0.00	10.00	7.33	7.80	73%*	78%
Chloroethane	0.52	10.00	8.93	12.37	84%	119%	0.00	10.00	9.88	10.51	99%	105%
Chloroform	0.00	10.00	9.09	13.39	91%	134%*	0.00	10.00	10.36	9.92	104%	99%
Methylene Chloride	0.00	10.00	8.92	12.33	89%	123%	0.00	10.00	9.21	9.07	92%	91%
Bromodichloromethane	0.00	10.00	8.84	10.93	88%	109%	0.00	10.00	9.62	9.91	96%	99%
Dibromochloromethane	0.00	10.00	8.65	10.08	86%	101%	0.00	10.00	9.87	9.77	99%	98%
Trichlorofluoromethane	0.00	10.00	7.42	5.98	74%*	60%*	0.00	10.00	8.83	9.96	88%	100%
Other Organic Analytes												
Acetone	0.00	10.00	11.53	21.67	115%	217%*	0.00	10.00	4.15	4.70	42%*	47%*
Bromomethane	0.00	10.00	6.88	10.09	69%	101%	0.00	10.00	7.99	8.31	80%	83%

Table F-5e. October 1997 MS and MSD Recovery Rate (%) (Continued)

Compound	WW-3						WW-1D					
	Unspiked (µg/L)	Spike Level (µg/L)	MS (µg/L)	MSD (µg/L)	MS Recovery (%)	MSD Recovery (%)	Unspiked (µg/L)	Spike Level (µg/L)	MS (µg/L)	MSD (µg/L)	MS Recovery (%)	MSD Recovery (%)
Benzene	0.00	10.00	9.17	10.18	92%	102%	0.00	10.00	9.57	9.77	96%	98%
Bromoform	0.00	10.00	8.94	10.03	89%	100%	0.00	10.00	9.62	9.41	96%	94%
2-Butanone	0.00	10.00	9.20	7.26	92%	73%*	0.00	10.00	5.24	5.34	52%*	53%*
Carbon Disulfide	0.00	10.00	9.84	7.55	98%	75%	0.00	10.00	9.92	9.73	99%	97%
Ethylbenzene	0.00	10.00	9.40	10.21	94%	102%	0.00	10.00	11.22	11.22	112%	112%
2-Hexanone	0.00	10.00	11.92	7.77	119%	78%	0.00	10.00	6.31	6.60	63%*	66%*
4-Methyl-2-pentanone	0.00	10.00	11.80	7.14	118%	71%*	0.00	10.00	5.68	6.55	57%*	66%*
Styrene	0.00	10.00	9.15	7.04	91%	70%*	0.00	10.00	9.55	10.60	96%	106%
Toluene	0.00	10.00	8.93	10.01	89%	100%	0.00	10.00	9.35	9.60	94%	96%
Vinyl Acetate	0.00	10.00	5.03	0.94	50%	9%*	0.00	10.00	3.26	3.02	33%*	30%*
m,p-Xylene	0.00	20.00	18.87	19.27	94%	96%	0.00	20.00	22.52	22.17	113%	111%
o-Xylene	0.00	10.00	9.23	10.45	92%	105%	0.00	10.00	11.20	11.07	112%	111%
Xylene	0.00	30.00	28.39	30.76	95%	103%	0.00	30.00	34.94	34.44	116%	115%

a. Recovery (%) is defined as [|MS(D) Level–Unspiked Sample|/Spike Concentration] x 100.

* Values outside of QC limits (75 - 125 %).

Table F-5f. October 1997 Method Blanks (%)

Compound	Method Blanks	
	Result	Detection Limit (µg/L)
Target Chlorinated Solvents		
PCE	U	0.5
TCE	U	0.5
cis-1,2-DCE	U	0.5
Vinyl Chloride	U	0.5
Other Chlorinated Solvents		
1,1-DCA	U	0.5
1,2-DCA	U	0.5
1,2-Dichlorobenzene	U	0.5
1,3-Dichlorobenzene	U	0.5
1,4-Dichlorobenzene	U	0.5
1,1-DCE	U	0.5
trans-1,2-DCE	U	0.5
1,1,2,2-Tetrachloroethane	U	0.5
1,1,1-Trichloroethane	U	0.5
1,1,2-Trichloroethane	U	0.5
Bromoform	U	0.5
Carbon Tetrachloride	U	0.5
Chloroethane	U	0.5
Chloroform	U	0.5
Methylene Chloride	U	0.5
Bromodichloromethane	U	0.5
Dibromochloromethane	U	0.5
Trichlorotrifluoromethane	U	2
Trichlorofluoromethane	U	0.5
Other Organic Analytes		
Acetone	U	2
Benzene	U	0.5
Bromomethane	U	0.5
2-Butanone	U	2
Carbon Disulfide	U	2
Chloromethane	U	0.5
Chlorobenzene	U	0.5
1,2-Dichloropropane	U	0.5
cis-1,3-Dichloropropene	U	0.5
trans-1,3-Dichloropropene	U	0.5
Ethylbenzene	U	0.5
2-Hexanone	U	2
4-Methyl-2-pentanone	U	2
Styrene	U	0.5
Toluene	U	0.5
Vinyl Acetate	U	2
Xylene	U	0.5

U: The analyte was not detected at or above the reporting limit.

Appendix G
Cost Issues

This section contains supplementary cost data used to project the cost of a full-scale permeable reactive barrier at Moffett Field. In this scenario, the full-scale permeable barrier would be constructed in two sections: the Site 9 wall would be 600 ft in length and the northern wall would be 1,100 ft in length.

Table G-1 lists cost elements used in the calculation according to EPA Work Breakdown Structure (WBS) number. Individual cost items were developed by NFESC based on preliminary projections prepared by site representatives (Tetra Tech).

Table G-2 contains present value cost comparison data for a full-scale permeable reactive barrier and pump-and-treat system at Moffett Field. A real rate of return of 8% was assumed in the calculation.

Table G-3 contains actual value cost comparison data for a full-scale permeable reactive barrier and pump-and-treat system at Moffett Field.

Figures G-1 through G-4 are sand channel maps for four discrete depths in the A aquifer.

Table G-1. Projected Cost of A Full-Scale Barrier at Moffett Field

WBS#	Cost Elements	Unit	Quantity	Unit Cost	Total Cost
	Capital Cost				
33	**Total Capital Cost**				**$4,992,363**
33.01	**Site Preparation**				**$115,258**
33.01.01.91	Procurement/equipment/material/subs	ea	1	$7,893	$7,893
33.01.01.92	Line locator/utility survey	ea	1	$17,984	$17,984
33.01.03.10	Traffic control plan	ea	1	$2,100	$2,100
33.01.03.27	Construction scheduling	ea	1	$2,100	$2,100
33.01.03.90	Coord./mutual understanding meeting	ea	1	$1,080	$1,080
33.01.03.91	Preconstruction meeting	ea	1	$1,080	$1,080
33.01.04.01	Office trailer	month	3	$440	$1,320
33.01.04.10	Toilets	month	5	$57	$287
33.01.04.11	Barricades	ft	9,216	$8	$77,414
33.01.05	Construct temporary utilities				$2,000
33.01.05.02	Power connection	ea	1	$1,000	$1,000
33.01.05.03	Telephone connection	ea	1	$1,000	$1,000
33.02	**Treatability Tests, Site Characterization, and Design**				**$292,820**
33.02.90	Site characterization	lsum	1	$100,000	$100,000
33.02.09.80	Bench-scale tests	lsum	1	$75,000	$75,000
33.02.09.90	Concrete characterization	ea	12	$1,000	$12,000
33.02.09.91	Asphalt test	ea	6	$705	$4,230
33.02.09.91	Welding	ea	6	$265	$1,590
33.02.91	Engineering design and modeling	lsum	1	$100,000	$100,000
33.03	**Construction**				**$3,740,825**
33.01.01.90	Construction equipment mobilization	ea	1	$39,693	$39,693
33.03.03.90	*Trench Installation*			*$557,812*	
	a. Trench excavation	yd^3	19,667	$6	$118,000
	b. Borrow, filter media, hauled	yd^3	13,111	$25	$322,009
	c. Backfilling	yd^3	19,667	$3	$67,063
	d. Grading	yd^2	756	$1	$567
	e. Compaction	yd^3	19,667	$3	$49,363
	f. Monitoring station	ea	6	$135	$810
33.06.90	*Gates Installation*			*$1,847,910*	
	a. Iron filing material, including freight	ton	2,518	$350	$881,300
	b. Iron freight	ton	2,518	$75	$188,850
	c. Iron prep and placement	ft^2	3,540	$10	$35,400
	d. Iron/slurry transition	ea	24	$30,000	$720,000
33.03.90	Receiving and Handling Iron	ton	2,518	$9	$22,360
	Funnel walls installation			*$1,237,584*	
33.06.03	Slurry Walls	ft^2	81,420	$11	$895,620
33.06.05	Sheet Piling	ft^2	16,284	$21	$341,964
33.21.04	Demobilization of Construction Equipment and Facilities			*$57,826*	
33.21.04.90	Demobilization of Construction Equipment	ea	1	$39,693	$39,693
33.03.04.90	Surface restoration total	yd^2	756	$24	$18,133
33.06	**Monitoring Wells Installation**	**ea**	**23**	**$2,000**	**$46,000**
33.18	**On-Site Spoils Disposal (Other than commercial)**				**$16,370**
33.18.03.01	Load/haul soils to on-site soil pile	yd^3	3,918	$3	$9,872
33.18.03.02	Pumping water into holding tank	day	18	$361	$6,498
33.19	**Off-Site Spoils Disposal (Commercial)**				**$387,989**
33.19.02	Transportation to disposal facility				$66,581
33.19.02.01	Load/haul/unload removed asphalt	yd^3	6,534	$10	$66,581
33.19.03.01	Landfilling fees for removed asphalt	yd^3	6,534	$39	$254,826
33.20	**Site Demobilization and Post-Construction Reports**				**$122,053**
33.20.06.05	Site cleanup	hr	320	$19	$6,032
33.21.01	*Removal of Temporary Facilities*			*$81,021*	

Table G-1. Projected Cost of A Full-Scale Barrier at Moffett Field (Continued)

WBS#	*Cost Elements*	*Unit*	*Quantity*	*Unit Cost*	*Total Cost*
33.19.02.01	Load/haul/unload removed asphalt	yd^3	6,534	$10	$66,581
33.19.03.01	Landfilling fees for removed asphalt	yd^3	6,534	$39	$254,826
33.20	**Site Demobilization and Post-Construction Reports**				**$122,053**
33.20.06.05	Site cleanup	hr	320	$19	$6,032
33.21.01	*Removal of Temporary Facilities*			*$81,021*	
33.21.01.01	Office trailer	ea	3	$440	$1,320
33.21.01.10	Toilets	ea	5	$57	$287
33.21.01.11	Barricades	lf	9,216	$8	$77,414
33.21.02.02	Removal of temporary utilities - Power connection	ea	1	$1,000	$1,000
33.21.02.03	Removal of temporary utilities - Telephone connection	ea	1	$1,000	$1,000
33.21	*Post Construction Submittals*			*$35,000*	
33.21.06	Final QA/QC report	lsum	1	$15,000	$15,000
	Construction document report	lsum	1	$10,000	$10,000
	As-built drawings	lsum	1	$10,000	$10,000
33.99	**Distributive Costs (Overheads Support)**				**$271,047**
33.99.01	Supervision/management	lsum	1	$180,430	$180,430
33.99.08	Temporary construction facilities	lsum	1	$4,333	$4,333
33.99.13	Vehicles for personnel	lsum	1	$19,600	$19,600
33.99.15	Health and safety	lsum	1	$5,000	$5,000
33.99.19	Home office costs	lsum	1	$61,684	$61,684
	Total estimated capital costs				**$4,992,363**
	Operating and Maintenance Costs				
	Operating Cost Incurred Every Year				**$72,278**
33	**Maintenance Cost Incurred in Each of Years 10, 20, and 30**				**$267,538**
33.02	**Monitoring, Sampling, and Analysis**				**$44,936**
33.02.07	Field sampling	lsum	1	$15,000	$15,000
33.02.09	Laboratory chemical analysis	sample	26	$536	$13,936
33.02.91	Sampling materials	lsum	1	$1,000	$1,000
33.02.92	Data evaluation, report	lsum	1	$15,000	$15,000
33.06	**Maintenance (once every ten years)**				**$267,538**
33.06.91	Iron replacement costs	ea	1	$267,538	$267,538
33.99	**Distributive Costs (every year)**				**$27,342**
33.99.01.00	*Supervision/Management*				
	a. Project Manager	hr	80	$46	$3,680
	b. Field project administrator	hr	80	$29	$2,320
	c. Project Superintendent	hr	120	$38	$4,560
	d. Health & Safety Officer	hr	40	$29	$1,160
	e. Quality control superintendent	hr	80	$46	$3,680
33.99.13	*Vehicles for personnel*				
33.99.13.01	Pickup trucks	month	1	$980	$980
33.99.15	*Health and Safety*				
33.99.15.17	Personal protective equipment	lsum	1	$1,000	$1,000
33.99.19	*Home Office Costs*				
33.99.19.90	Program management office support	lsum	9,516	$1	$9,516
33.99.19.91	Project closeout	lsum	1	$446	$446

Table G-2. Present Value Comparison of Pump-and-Treat and Permeable Reactive Barrier Alternatives

Year	Discount Factor (8% APR)	P&T Cost	PV(P&T)	PV(P&T) - Cumulative	PRB Cost	PV(PRB)	PV(PRB) - Cumulative
0	1.000	$1,412,086	$1,412,086	$1,412,086	$4,910,943	$4,910,943	$4,910,943
1	0.926	$694,746	$643,283	$2,055,369	$72,278	$66,924	$4,977,867
2	0.857	$694,746	$595,633	$2,651,002	$72,278	$61,967	$5,039,834
3	0.794	$694,746	$551,512	$3,202,514	$72,278	$57,377	$5,097,210
4	0.735	$694,746	$510,659	$3,713,173	$72,278	$53,126	$5,150,337
5	0.681	$694,746	$472,832	$4,186,005	$72,278	$49,191	$5,199,528
6	0.630	$694,746	$437,808	$4,623,813	$72,278	$45,547	$5,245,075
7	0.583	$694,746	$405,378	$5,029,191	$72,278	$42,174	$5,287,249
8[a]	0.540	$694,746	$375,350	**$5,404,540**	$72,278	$39,050	**$5,326,299**
9	0.500	$694,746	$347,546	$5,752,086	$72,278	$36,157	$5,362,456
10	0.463	$694,746	$321,802	$6,073,888	$339,816	$157,401	$5,519,856
11	0.429	$694,746	$297,965	$6,371,853	$72,278	$30,999	$5,550,855
12	0.397	$694,746	$275,893	$6,647,746	$72,278	$28,703	$5,579,558
13	0.368	$694,746	$255,457	$6,903,203	$72,278	$26,576	$5,606,134
14	0.340	$694,746	$236,534	$7,139,737	$72,278	$24,608	$5,630,742
15	0.315	$694,746	$219,013	$7,358,750	$72,278	$22,785	$5,653,527
16	0.292	$694,746	$202,790	$7,561,539	$72,278	$21,097	$5,674,624
17	0.270	$694,746	$187,768	$7,749,308	$72,278	$19,534	$5,694,159
18	0.250	$694,746	$173,860	$7,923,167	$72,278	$18,087	$5,712,246
19	0.232	$694,746	$160,981	$8,084,148	$72,278	$16,748	$5,728,994
20	0.215	$694,746	$149,057	$8,233,205	$339,816	$72,907	$5,801,901
21	0.199	$694,746	$138,015	$8,371,220	$72,278	$14,358	$5,816,259
22	0.184	$694,746	$127,792	$8,499,012	$72,278	$13,295	$5,829,554
23	0.170	$694,746	$118,326	$8,617,338	$72,278	$12,310	$5,841,864
24	0.158	$694,746	$109,561	$8,726,899	$72,278	$11,398	$5,853,262
25	0.146	$694,746	$101,445	$8,828,344	$72,278	$10,554	$5,863,816
26	0.135	$694,746	$93,931	$8,922,275	$72,278	$9,772	$5,873,588
27	0.125	$694,746	$86,973	$9,009,248	$72,278	$9,048	$5,882,636
28	0.116	$694,746	$80,531	$9,089,779	$72,278	$8,378	$5,891,015
29	0.107	$694,746	$74,565	$9,164,344	$72,278	$7,757	$5,898,772
30	0.099	$694,746	$69,042	$9,233,386	$339,816	$33,770	$5,932,542
31	0.092	$694,746	$63,928	$9,297,314	$72,278	$6,651	$5,939,193
32	0.085	$694,746	$59,192	$9,356,506	$72,278	$6,158	$5,945,351
33	0.079	$694,746	$54,808	$9,411,314	$72,278	$5,702	$5,951,053
34	0.073	$694,746	$50,748	$9,462,062	$72,278	$5,280	$5,956,332
35	0.068	$694,746	$46,989	$9,509,051	$72,278	$4,888	$5,961,221
36	0.063	$694,746	$43,508	$9,552,559	$72,278	$4,526	$5,965,747
37	0.058	$694,746	$40,285	$9,592,844	$72,278	$4,191	$5,969,938
38	0.054	$694,746	$37,301	$9,630,145	$72,278	$3,881	$5,973,819
39	0.050	$694,746	$34,538	$9,664,684	$72,278	$3,593	$5,977,412
40	0.046	$694,746	$31,980	$9,696,663	$339,816	$15,642	$5,993,054
41	0.043	$694,746	$29,611	$9,726,274	$72,278	$3,081	$5,996,135
42	0.039	$694,746	$27,418	$9,753,692	$72,278	$2,852	$5,998,987
43	0.037	$694,746	$25,387	$9,779,078	$72,278	$2,641	$6,001,628
44	0.034	$694,746	$23,506	$9,802,585	$72,278	$2,445	$6,004,074
45	0.031	$694,746	$21,765	$9,824,350	$72,278	$2,264	$6,006,338
46	0.029	$694,746	$20,153	$9,844,502	$72,278	$2,097	$6,008,435
47	0.027	$694,746	$18,660	$9,863,162	$72,278	$1,941	$6,010,376
48	0.025	$694,746	$17,278	$9,880,440	$72,278	$1,797	$6,012,173
49	0.023	$694,746	$15,998	$9,896,438	$72,278	$1,664	$6,013,838
50	0.021	$694,746	$14,813	$9,911,251	$339,816	$7,245	$6,021,083

(a) At year 8, the estimated costs for the P&T and PRB alternatives are approximately equivalent.

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Table G-3. Actual Value Comparison of Pump-and-Treat and Permeable Reactive Barrier Alternatives

Years of Operation	Actual Cost for PRB	Actual Cost for P&T
0	$ 4,910,943	$ 1,412,086
1	$ 4,983,221	$ 2,106,832
2	$ 5,055,499	$ 2,801,578
3	$ 5,127,777	$ 3,496,324
4	$ 5,200,055	$ 4,191,070
5	$ 5,272,333	$ 4,885,816
6[a]	**$ 5,344,611**	**$ 5,580,562**
7	$ 5,416,889	$ 6,275,308
8	$ 5,489,167	$ 6,970,054
9	$ 5,561,445	$ 7,664,800
10[b]	**$ 5,901,261**	$ 8,359,546
11	$ 5,973,539	$ 9,054,292
12	$ 6,045,817	$ 9,749,038
13	$ 6,118,095	$ 10,443,784
14	$ 6,190,373	$ 11,138,530
15	$ 6,262,651	$ 11,833,276
16	$ 6,334,929	$ 12,528,022
17	$ 6,407,207	$ 13,222,768
18	$ 6,479,485	$ 13,917,514
19	$ 6,551,763	$ 14,612,260
20[b]	**$ 6,891,579**	$ 15,307,006
21	$ 6,963,857	$ 16,001,752
22	$ 7,036,135	$ 16,696,498
23	$ 7,108,413	$ 17,391,244
24	$ 7,180,691	$ 18,085,990
25	$ 7,252,969	$ 18,780,736
26	$ 7,325,247	$ 19,475,482
27	$ 7,397,525	$ 20,170,228
28	$ 7,469,803	$ 20,864,974
29	$ 7,542,081	$ 21,559,720
30[b]	**$ 7,881,897**	$ 22,254,466
31	$ 7,954,175	$ 22,949,212
32	$ 8,026,453	$ 23,643,958
33	$ 8,098,731	$ 24,338,704
34	$ 8,171,009	$ 25,033,450
35	$ 8,243,287	$ 25,728,196
36	$ 8,315,565	$ 26,422,942
37	$ 8,387,843	$ 27,117,688
38	$ 8,460,121	$ 27,812,434
39	$ 8,532,399	$ 28,507,180
40[b]	**$ 8,872,215**	$ 29,201,926
41	$ 8,944,493	$ 29,896,672
42	$ 9,016,771	$ 30,591,418
43	$ 9,089,049	$ 31,286,164
44	$ 9,161,327	$ 31,980,910
45	$ 9,233,605	$ 32,675,656
46	$ 9,305,883	$ 33,370,402
47	$ 9,378,161	$ 34,065,148
48	$ 9,450,439	$ 34,759,894
49	$ 9,522,717	$ 35,454,640
50[b]	**$ 9,862,533**	$ 36,149,386

(a) At year 6, the estimated costs for the P&T and PRB alternatives are approximately equivalent.
(b) Barrier maintenance cost of $267,538 added every 10 years.

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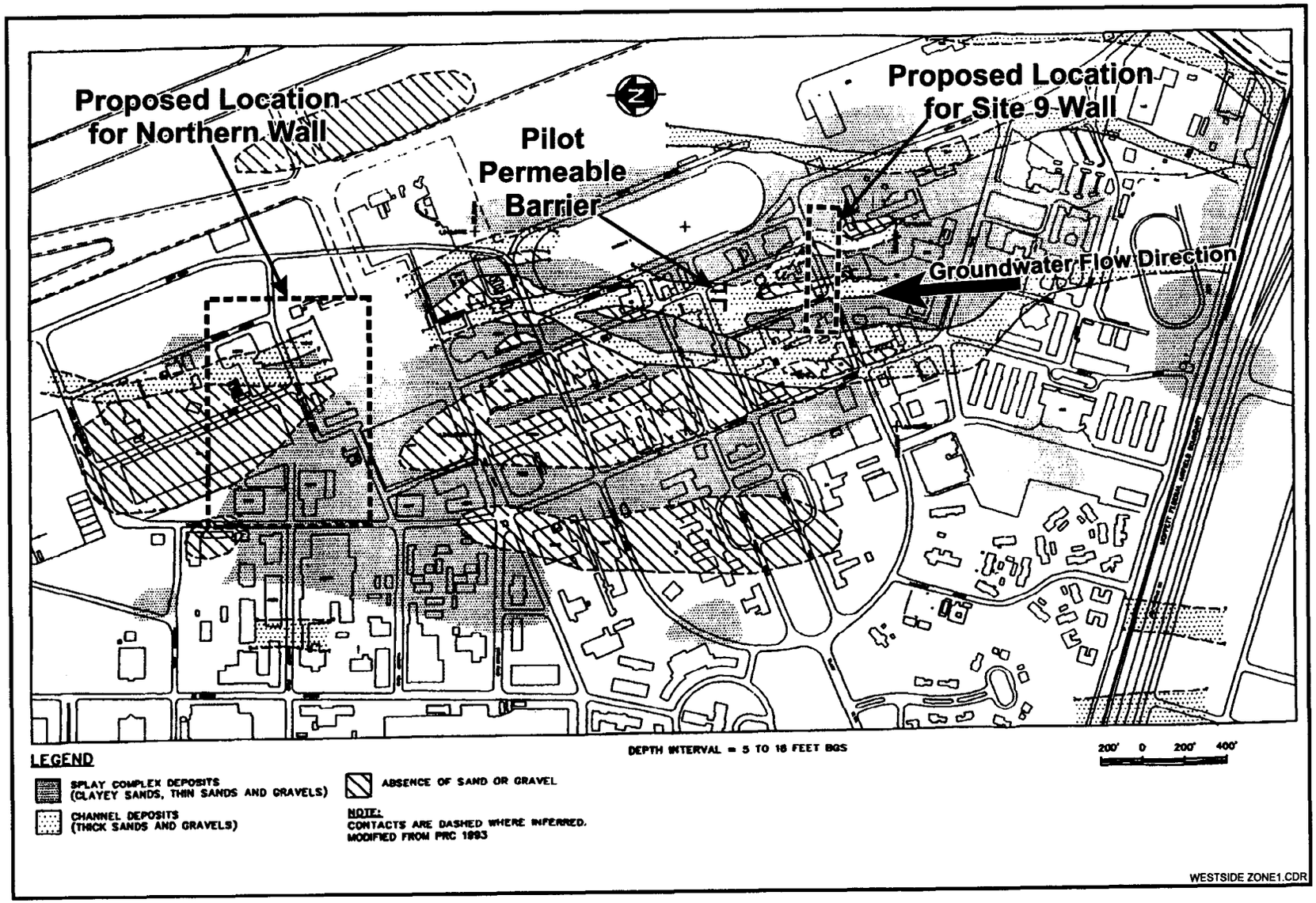

Figure G-1. Sand Channel Map (Depth 5 to 18 ft bgs) at Moffett Field (Source: NFESC, 1995)

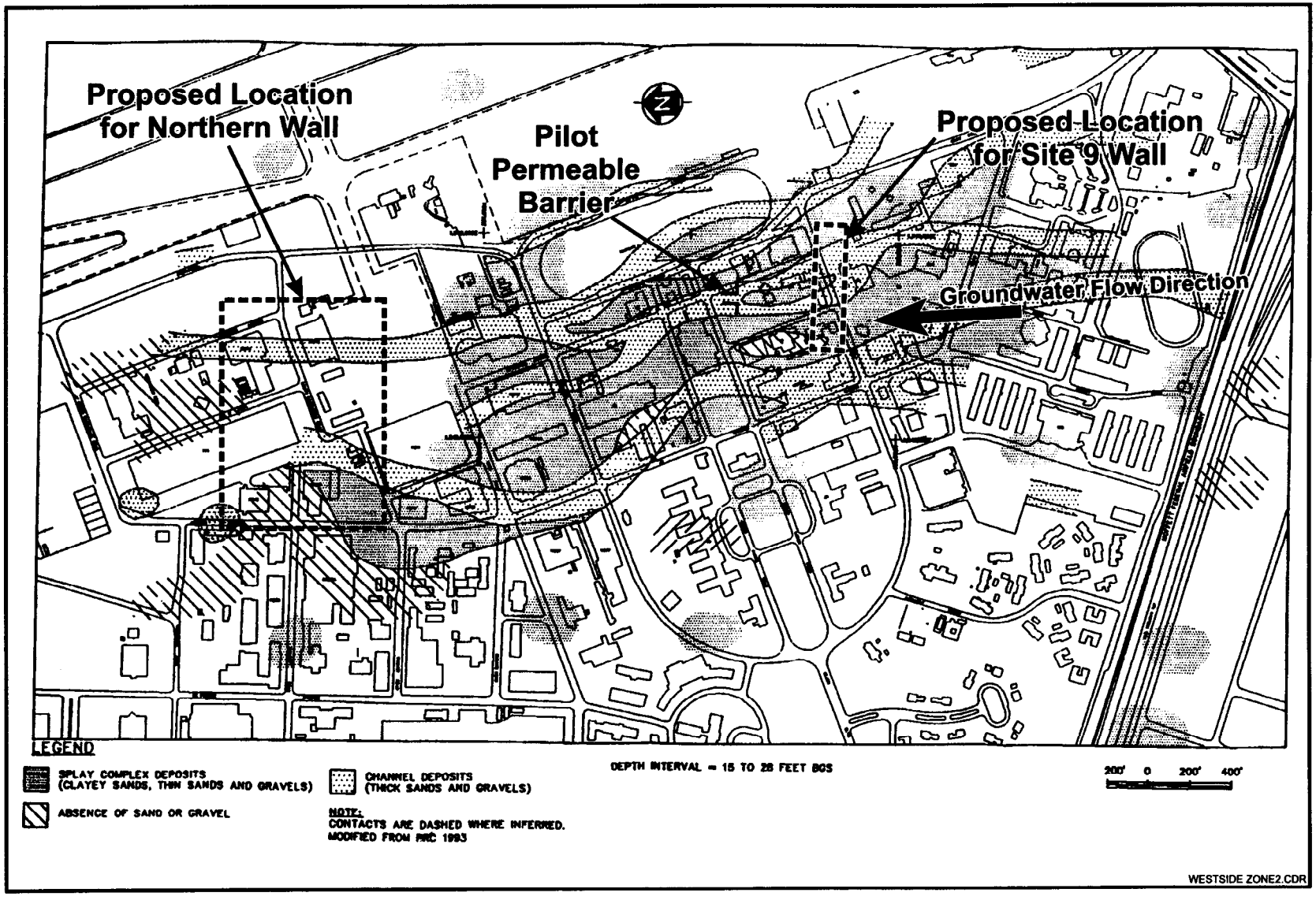

Figure G-2. Sand Channel Map (Depth 15 to 28 ft bgs) at Moffett Field (Source: NFESC, 1995)

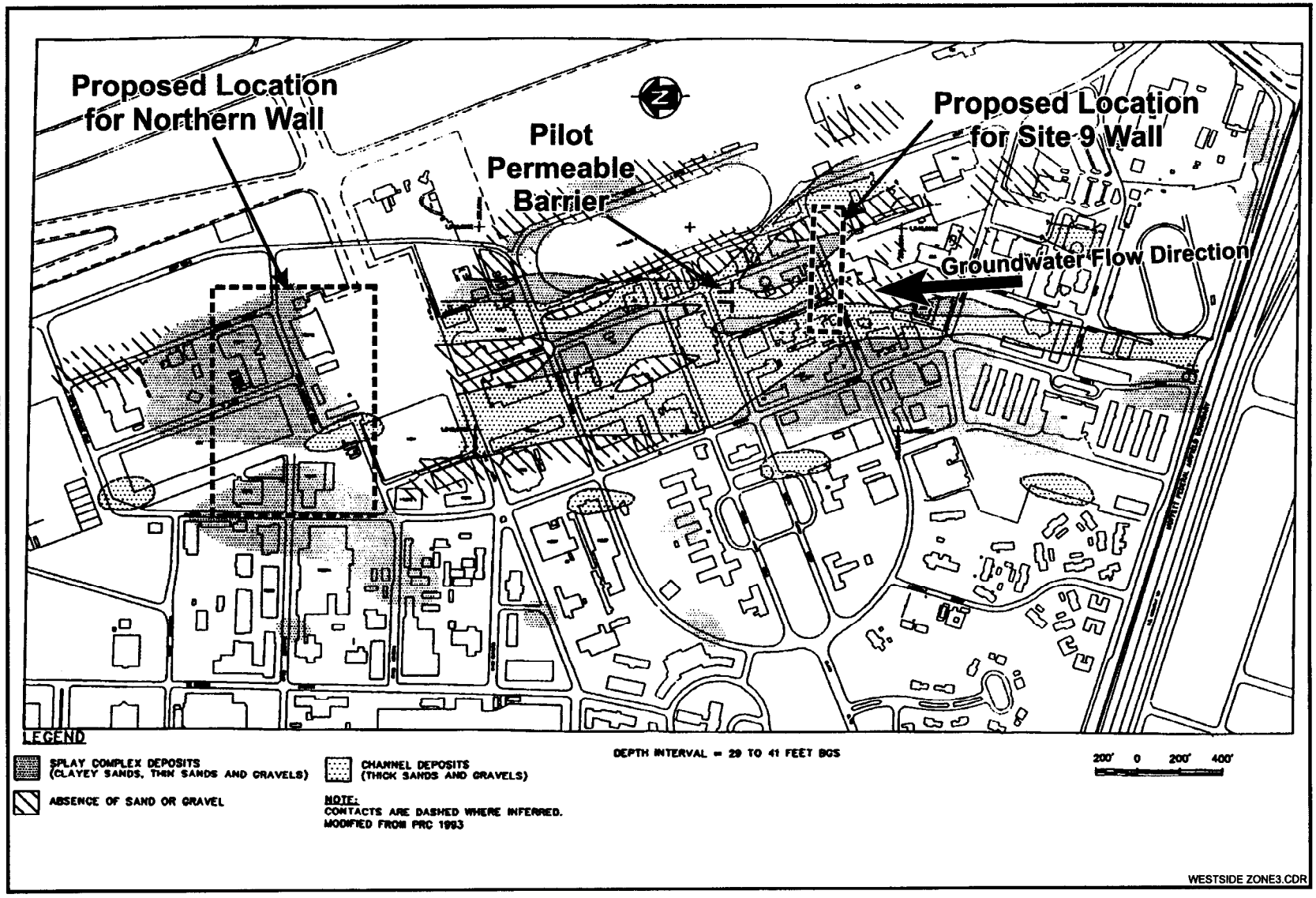

Figure G-3. Sand Channel Map (Depth 29 to 41 ft bgs) at Moffett Field (Source: NFESC, 1995)

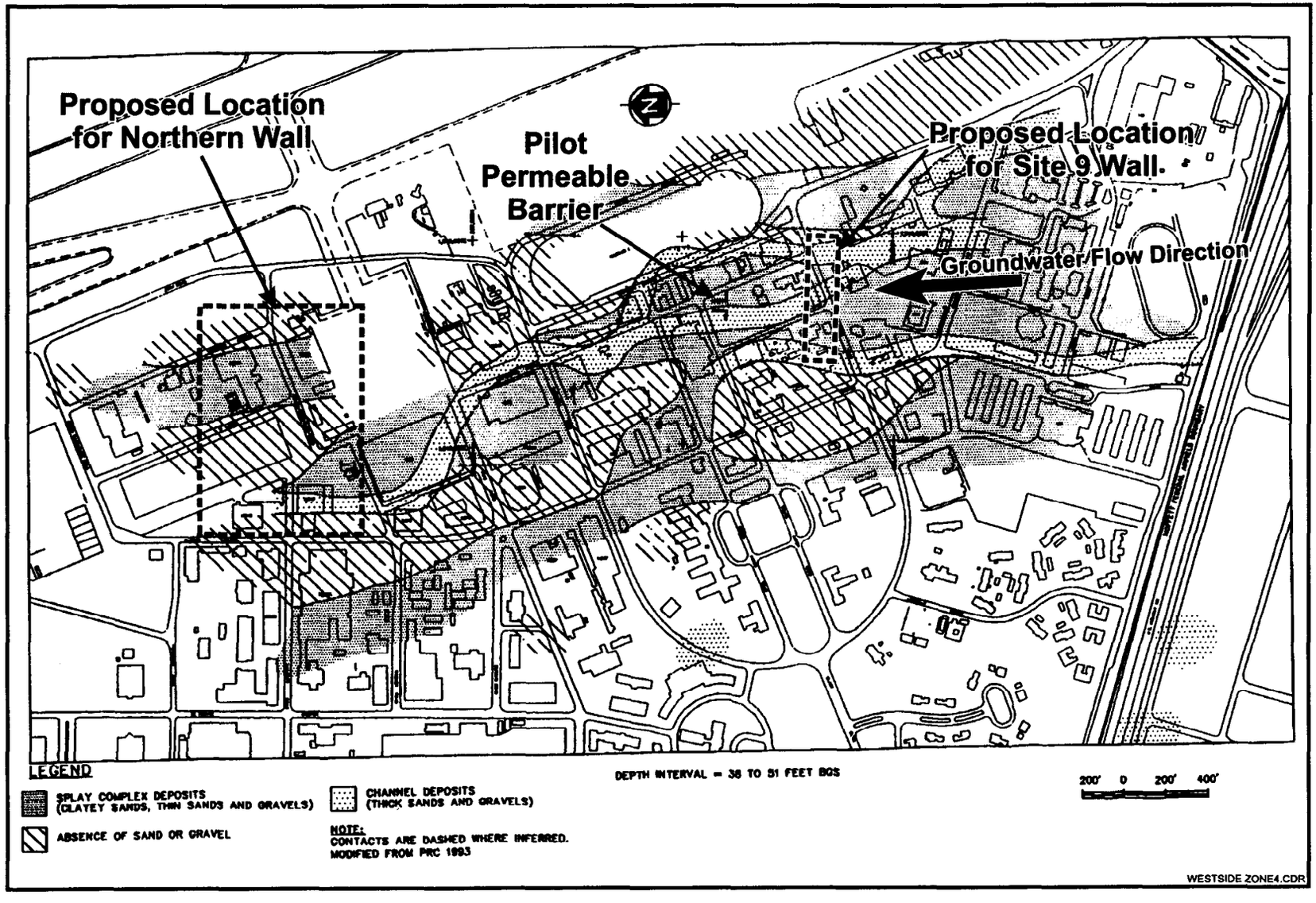

Figure G-4. Sand Channel Map (Depth 38 to 51 ft bgs) at Moffett Field (Source: NFESC, 1995)